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(57) Abstract

A system and method for improving voice quality of priority calls in a radiocommunication system modifies the transmitted power of the mobile station instituting a priority call and the transmitted power of co–channel mobile stations that are estimated as interfering with the priority call. The serving mobile switching center and/or base station analyzes parameters contained in call origination messages and increases the transmission power of the mobile station that is designated as priority status. If this increase in transmitted power is insufficient to adequately improve the priority call voice quality, the system further reduces the transmitted power levels associated with co–channel mobile stations so as to attain a desired voice quality level.

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Improved Voice Quality of High Priority Calls in a Radio Communication System

BACKGROUND

Applicant's invention relates generally to radiocommunication systems, e.g., cellular or satellite systems and, more particularly, to techniques for supporting and enhancing emergency calling procedures in such systems.

The growth of commercial radiocommunications and, in particular, the explosive growth of cellular radiotelephone systems have changed the ways in which people communicate. One survey indicates that about 80% of the people who purchase mobile communication units and service subscriptions do so to enhance their personal security. Presumably, many of these subscribers would expect to use their mobile units to aid them in urgent situations, e.g., when their vehicle has become disabled or in an emergency situation requiring rapid medical and/or police response. Often, in emergency situations, a cellular phone is the closest point of access to an emergency response center. Consequently, an increasing proportion of emergency calls are now made using cellular phones. A number of problems associated with cellular telecommunications systems, however, makes it problematic for users of these systems to institute emergency or high priority calls.

One problem associated with cellular telecommunications systems is the limitation on the number of RF channels available to any given mobile subscriber. During peak hours there is a significant probability that a channel will not be able to be allocated to a mobile subscriber originating an emergency call due to network congestion. In public switched telephony networks (PSTNs) it has been a conventional technique for many years to give emergency calls higher priority when network congestion exists. This concept has also been applied to cellular systems.

Another drawback with cellular telecommunications systems is that voice quality is usually inferior to that of a PSTN. In certain instances, the voice quality is so poor

that conversation is distorted such that words and entire sentences become incomprehensible. In some cells in the network, up to 5% of all calls are dropped due to poor carrier to interference ratio (C/I). While distortion and interruption is merely an inconvenience during a social or business call, the consequences are far more serious when it comes to emergency calls.

Accordingly, it would be desirable to provide a technique that increases the carrier to interference ratio of emergency or high priority calls so as to improve voice quality and to decrease the likelihood of call dropping.

SUMMARY

These desirable characteristics and others are provided by the following exemplary embodiments of the invention.

According to one exemplary embodiment of the invention a method for improving voice quality of calls in a radiocommunications network is provided. The method of this exemplary embodiment comprises the steps of: designating said calls as high priority based on a transmitted parameter associated with said calls; and said network modifying transmitted power associated with said calls based on said high priority designation so as to improve the voice quality of said calls over at least a portion of said calls.

According to a second exemplary embodiment of the invention a method for improving voice quality of calls in a radiocommunication network is provided. The method of this exemplary embodiment comprises the steps of: designating said calls as high priority based on a transmitted parameter associated with said calls; and modifying transmitted power of calls other than said high priority calls, based on said high priority designation, so as to improve said voice quality over at least a portion of said designated high priority calls.

According to a third exemplary embodiment of the invention a system for improving voice quality of calls in a radiocommunications network is provided. The system of this exemplary embodiment comprises: means for designating said calls as

high priority based on a transmitted parameter associated with said calls; and means for modifying transmitted power associated with said calls based on said high priority designation so as to improve the voice quality of said calls over at least a portion of said calls.

According to a fourth exemplary embodiment of the invention a system for improving voice quality of calls in a radiocommunication network is provided. The system of this exemplary embodiment comprises: means for designating said calls as high priority based on a transmitted parameter associated with said calls; and means for modifying transmitted power of calls other than said high priority calls, based on said high priority designation, so as to improve said voice quality over at least a portion of said designated high priority calls.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and advantages of the invention will be understood by reading the following detailed description in conjunction with the drawings in which:

FIG. 1 is a message sequence chart in accordance with exemplary embodiments of the invention;

FIG. 2 is a flow diagram depicting the steps for modifying the high priority call transmitted power in accordance with exemplary embodiments of the invention; and

FIG. 3 is a flow diagram depicting the steps for modifying the transmitted power associated with co-channel mobile stations in accordance with exemplary embodiments of the invention.

FIG. 4 is a block diagram of a cellular communication system that advantageously incorporates the cell relation determination method of the present invention.

FIG. 5 is a diagram of a matrix representing the distribution of a cell relation parameter used in the method of the present invention.

FIG. 6 is a diagram of a histogram representing an exemplary distribution of cell relation parameters.

DETAILED DESCRIPTION

To improve the voice quality of high priority calls, the exemplary embodiments of the invention improve the carrier to interference ratio (C/I) of the uplink by a factor ΔQ. This is achieved by analysis of a call origination message typically associated with a mobile call. In a radiocommunications network employing the ANSI-136 specification, for example, a call origination message is sent to the serving base station (BS) over the control channel. The BS forwards this origination message to the mobile switching center (MSC) including parameters such as the emergency call flag. As illustrated in the exemplary embodiment of Figure 2, the MSC analyzes (19) the origination message to determine if the emergency flag is set (20). If the emergency flag is set the MSC designates the call as high priority status (21). In an additional exemplary embodiment, the BS, instead of the MSC, will analyze (19) the origination message to determine if the emergency flag is set. Based on this analysis, the BS can similarly designate the call as high priority status (21).

When a voice channel becomes available in the cell associated with the serving base station, the mobile switching center orders the base station to send the digital traffic channel designation message to the mobile station over the control channel. In this message, the DMAC information element indicates the initial transmission power level of the mobile station when the mobile station is assigned to a digital traffic channel. According to this exemplary embodiment of the invention, the base station will set the DMAC information element to a level ΔQ higher (22, Figure 2) than is normal for a non-emergency call in that cell (and/or that particular connection if it were to be set-up as a non-emergency call). Though any value, for example, between 2-8 dB for ΔQ can be selected, ΔQ=4 dB is a practical value. A ΔQ of 4 dB is large enough to cause a perceivable increase in voice quality, but will not unduly impair the general system performance. Due to the increase in the mobile station power level, the probability of call set-up will be improved. Subsequent to the initial set-up power level, power change commands can be issued from the base station to the mobile station to raise or lower the mobile power. Once the mobile station has tuned to the designated

voice channel, a conventional power control algorithm can be used (23, Figure 2) with the modification that the mobiles target power is set ΔQ higher than it would be for a normal call. The mobile station power level is conveyed in a conventional manner by the physical layer power control change message.

Though the above exemplary embodiment increases the power on the uplink from the mobile station, downlink radiated power can similarly be controlled during a high priority call if the base station has power control capability. In the event of a high priority call, the base station will increase the radiated power on the RFCH carrying the call. This power increase need not be the same as on the uplink. However, similar to the uplink, a 4 dB increase is a practical value. In a TDMA system such as that described by ANSI 136, for example, only the downlink radiated power of the time slot carrying the high priority call will be increased.

In an additional exemplary embodiment, a call can attain the status of a high priority call even if the emergency flag in the origination message isn't set. The base station or mobile switching center can designate a call as high priority by analyzing the Called Party Number (CPN) in the origination message (26, Figure 2). If the CPN of the call is on a list of high priority CPN's, then the call will be designated a high priority call and the uplink and/or downlink power will be increased as discussed in the exemplary embodiments above. Similarly, the mobile switching center can analyze the mobile subscriber identity in the origination message (27, Figure 2) to determine whether the subscriber is entitled to a high priority call.

When intercell hand-off of an in-progress priority call is required, then the mobile switching center shall set the DMAC in the hand-off message to a specified higher level. Furthermore, the mobile switching center will inform the new serving base station that the mobile is engaged in a high priority call. The new serving base station will then handle the high priority call in the same manner as the original serving base station.

Raising the mobile station or base station power level, as described in the exemplary embodiments above, may not alone be sufficient to improve the voice quality

of high priority calls since the increased transmission power levels can be offset by signal interference. In general, this interference is primarily caused by co-channel interference, i.e., interference caused by at least one mobile transmitting in the same RF channel from a surrounding cell. In order to mitigate co-channel interference, exemplary embodiments of the present invention reduce the power levels of one or more co-channel mobiles. The objective of this co-channel mobile power level reduction is to ensure that the priority call uplink C/I is above an uplink quality threshold (UQT) (e.g., 19 dB < UQT <23 dB).

To ensure that the uplink C/I is above the UQT, a base station receiving a high priority call will monitor the uplink C/I. If the high priority call is digital, then the C/I ratio may be estimated by translating the uplink bit error ratio (BER) according to an empirical table as is known in the art. If the high priority call is analogue, than the C/I ratio can be estimated by analyzing the supervisory audio tone as is also known in the art.

As shown in the exemplary embodiments of Figures 1 and 3, a base station carrying a high priority call detects whether the mobile station is transmitting at its maximum power and whether the uplink C/I is below the uplink quality threshold (1 and 2, Figure 3). If these conditions are met the base station will send the message 'InSufUpQual' (12, Figure 1) to the mobile switching center (MSC) (13, Figure 1). This message will include parameters C/I_{old} and i_{old}, where i_{old} is calculated by the base station using the received signal strength level RSSI and the following relation:

$$i_{old}=RSSI-C/I_{old} \qquad \text{Eqn. (1)}$$

After receipt of the InSufUpQual message, the MSC will then determine which co-channel mobiles are potentially causing significant interference (14, Figure 1). This determination is achieved as illustrated in steps 3-11 of Figure 3. The objective of steps 3-11 is to decrease the power of at least one of the most interfering co-channel mobiles so that C/I_{new} > UQT (4, Figure 3). The desired change of C/I is $\Delta Q=C/I_{new}-C/I_{old}$ (5, Figure 3). Assuming, for this example, that the mobile station making the emergency call is

transmitting at its maximum power, C cannot be increased, which means that i_{old} must be decreased by ΔQdB. The desired interference ($i_{desired}$) is thus given by:

$$i_{desired} = i_{old} - \Delta Q \qquad \text{Eqn. (2)}$$

$i_{desired}$ therefore represents the total desired interference due to co-channel mobiles residing in neighboring cells. The interference contribution of each co-channel mobile can be estimated using a simple model. In this model, the interference contribution of each mobile station (ms_j) at a base station (bs_i) can be modeled as a function of the power radiated (P_j) by the mobile station and the path gain $g_{bsi,msj}$ between the mobile station and the base station. This functional relationship can be expressed as follows:

$$i_{bsi,msj} = g_{bsi,msj} * P_j \qquad \text{Eqn (3)}$$

For every $cell_i$, associated with a base station bsi_i, the total interference caused by *n* co-channel mobile stations is given by:

$$i_{i,tot} = \sum_{j=1}^{n} g_{bsi,msj} * P_j \qquad \text{Eqn (4)}$$

where $g_{bsi,msj}$ is the path gain between bs_i and ms_j and P_j is the power transmitted by ms_j.

The radiated power (P_j) of all mobile stations is known by the system, however, the path gains ($g_{bsi,msj}$) are not known and must be estimated. A number of models for estimating path gains are known in the art. These known models, however, require knowledge of the positions of the co-channel mobile as well as the terrain type between the co-channel mobile and the base station. Thus, exemplary embodiments of the present invention will estimate path gain using empirical data. An exemplary empirical technique for use in the present invention is disclosed in U.S. Patent Application No. 09/162,122, entitled “A Method for Acquisition of Cell Relations in a Cellular Radio Communications System”, the disclosure of which is herein incorporated by reference. This empirical technique measures and records mobile station uplink power over time and then estimates path gain for each pair of cells in the system based on the uplink power measurements.

For illustrating the exemplary path gain estimation technique of the present invention, Figure 4 shows a block diagram of an exemplary cellular communication system 50 that serves a cellular coverage area 100. The cellular coverage area is divided into a number of cells designated as C1-C8 within which mobile stations MS1-MS8 are served. The communication system 1 includes a Mobile Switching Center (MSC) 110 that provides central control over communication activity within the coverage area 100. Preferably, the MSC 110 is connected to a PSTN 114 for providing wireless communication among the mobile stations MS1-MS8 and PSTN subscribers. The wireless communication capability is provided through radio links established by a number of base station BS1-BS8, which serve a corresponding one of the cells C1-C8.

Operationally, the base stations BS1-BS8 transmit downlink information to the mobile stations on designated downlink radio frequency channels and receive uplink information from the mobile stations on designated uplink radio frequency channels. Similarly, the mobile stations MS1-MS8 receive the downlink information on the downlink radio frequency channels and transmit the uplink information on the uplink radio frequency channels. As described before, the transmitted information on uplink or downlink directions may be received, not only by an intended receiver within the cell of a transmitting source, but also by non-intended receivers that are located within the communication system 50. For example, upon transmission of downlink information to MS1 from BS1 over a cell C1 assigned radio frequency channel f_1, another mobile station MS5 in cell C5 may also receive the BS1 transmitted downlink information, if cell C5 is assigned the same downlink frequency f_1, causing co-channel interference. Similar co-channel interference may be caused at the base stations by uplink transmissions from the mobile stations over the same uplink radio frequency channel. For example, as shown in FIG. 4, the base station BS5 in cell C5 may receive uplink information on frequency f_{11}, which is the uplink radio frequency channel used for transmission of uplink information in cell C1. Again, if cell C1 and cell C5 are assigned the same uplink radio frequency channel f_{11}, simultaneous uplink transmissions at these cells may cause interference at the corresponding base stations. For efficient

control of voice quality, it is therefore necessary to determine the downlink and uplink cell relations for each cell relative to all other cells in terms of such parameters as path gain values.

In order to accurately determine the uplink and downlink cell relations among the cells, it is important to measure received signal strength from a single transmission source within a cell, otherwise cell relations acquired would be affected by transmissions from several cells, thereby causing less reliable measurements. According to one aspect of the present invention, each one of the base stations BS1-BS8 measures received signal strength over a number of radio frequency channels at a predefined rate, e.g., 50 radio frequency channels per second. In the TDMA arrangement, each base station scans the radio frequency channel, for example, via a scanning receiver, and measure the received signal strengths over a predetermined number of time slots. In a CDMA or FDMA implementation, the base station may scan the radio frequency channels and measure received signal strengths over each radio frequency channel during predefined time intervals. Therefore, the base stations BS1-BS8 continuously report to the MSC 110 the measured received signal strengths over each one of the radio frequency channels along with a corresponding measurement time.

The MSC 110, which is aware of all communication activity within the coverage area 100, maintains a record of all ongoing calls within the cells C1-C8, including a record of radio frequency channels allocated to each one of calls at any particular time. Based on the call record and the reported information from the base stations, the MSC determines which one of the received signal strength measurements corresponds to a measurement from a single transmission source within a cell. More specifically, the MSC 110 determines whether at a particular measurement time, the measured radio frequency channel was assigned to a call in a single cell or to calls in multiple cells, for example, in cells that re-use the measured radio frequency channel. If a measured radio frequency channel is assigned to a single cell at the measurement time, the corresponding signal strength measurement at the base station is selected and stored in the MSC 110 as a parameter for determining the cell relations among the cells.

Otherwise, if at the measurement time, the measured radio frequency channel was simultaneously used in two or more cells, the corresponding signal strength measurement is discarded, because it potentially represents contributions from multiple transmission sources. Therefore, for uplink cell relation calculations, the present invention uses received signal strength measurements over those radio frequency channels that are found to be used for originating uplink transmissions from a single transmitter.

In order to express cell relations in terms of path gain values, it is necessary to determine the factor by which an uplink or downlink transmitted signal is attenuated before it is received. Such factor is determined based on a received signal strength at the receiver and the transmit power level at the transmitter. In the exemplary communication system 50, the base stations BS1-BS8 are equipped to instruct the mobile stations positioned within their corresponding cells to increment and decrement their power level in a well known manner. Such increment or decrement of mobile stations' power levels, which are based on a received signal strength form the mobile stations, is relative to a reference power level provided by the MSC 110. Therefore, the MSC 110 may determine path gain values based on transmit power level information at the mobile stations, when received signal strengths are measured at the base stations.

In order to determine path gain values, the base stations BS1-BS8 con tinuously provide time stamped transmit power reports relating to the power output of the mobile stations MS1-MS8 at various times to the MSC. By time correlating the transmit power information and selected, i.e., un-discarded, received signal strength measurements stored in the MSC 110, path gain values may be calculated for expressing the cell relations between any two cells.

Due to various factors, the values of measured cell relation parameter amongst the cells may vary significantly. Thus, a distribution function is used when considering the measured parameters that establish cell relations. As described before, the cell relations may be expressed in terms of path gain values. FIG. 5 shows the cell relations being represented in the MSC 110 by a matrix that includes different storage locations

for each possible combination of cell pairs and their respective cell relation measurements. One dimension of the matrix corresponds to base stations BS1-BS8 in cells where received signal strength is measured, and the other matrix dimension corresponds to cells C1-C8 from which the received signals were transmitted. For example, by calculating path gain values based on continuous measurement of received signal strengths over the radio frequency channels, path gain distributions may be calculated for expressing relations between each pair of two cells according to corresponding histograms. The histograms, which are shown as curved graphs in some of the storage locations of the matrix, correspond to the distributions of path gain values between any two cells.

FIG. 6 shows an exemplary histogram derived after the convergence of the distribution of the path gain values. The X-axis corresponds to the path gain values, which are expressed in dB, with the path gain assuming a value in the range of -120 dB and -80 dB. The Y-axis of the diagram shows the probability, in percentage, of a certain path gain value occurring between two cells. The histogram is represented by stacks of mutually different heights, with the combined height of the stacks corresponding to a 100% probability. The height of each stack illustrates the probability of a receiver receiving from a transmitter in a cell precisely a path gain corresponding to a received signal strength represented by the stack. Each stack has a width of 1 dB. For example, in the illustrated histogram, the probability of a corresponding base station in the matrix obtaining a path gain value of -100 dB for a signal received from a transmitter in a corresponding cell in the matrix is 4%.

The histogram is generated by accumulating the path gain values continuously and assigning such values a corresponding probability value. For example, when an amplification value representing -110 dB is sampled, the stack corresponding to this value is raised in the illustrated case by a predetermined parameter corresponding to 1/100th of a percent. The method proceeds until the total height of the stacks for the sampled values reach 100%. When the combined height of the stacks has reached 100%, the histogram is normalized as the values are collected. After sampling a path

gain value, the stack that represents this value is raised by the predetermined parameter, i.e. by 1/100th of a percent. All stacks are then lowered proportionally, such as to lower the combined height of the stacks by 1/100th of a percent. This process continues until the distribution of path gain values for each pair of cells converges and becomes stable. One conceivable alternative to the illustrated method of generating a histogram is to have a start distribution already at the beginning of the start-up phase and to normalize the histogram already at this point.

Thus, using the above described path gain estimation techniques, the distribution of path gain is estimated for each pair of cells in the system. For each distribution an arbitrary percentile of the path gain can be calculated. For example g.96 denotes the 96% percentile, i.e. 96% of the distribution is below that value. In the illustrated histogram (Fig. 6) g.96 is -84 dB. The 95% percentile is a suitable tradeoff and will be used for all estimated path gains in the remaining of this disclosure. For simplicity g will denote the 95% percentile of a path gain g.

One skilled in the art will recognize that, though downlink path gains differ from the uplink path gains, the downlink path gains may be estimated in a manner similar to that described above. The downlink gain matrix may also be calculated in a similar fashion. Therefore, using the model disclosed in U.S. Patent Application No. 09/162,122 and described above, path gains can be empirically estimated as shown at step 28 of Figure 3.

The power at which a mobile station (ms_j) transmits is determined by the power level L at which the mobile has been set, where L represents the number of levels that the power has been attenuated. In (D)Amps, for example, the relationship between L and the radiated power P(L) is defined in IS-136 2.1.2.2. L_j denotes the maximum power level (or minimum attenuation) in $cell_j$. Thus, the predicted interference in $cell_i$ from $cell_j$ can be expressed as:

$$i_{i,j}(L_j)=g_{i,j}*P(L_j) \qquad \text{Eqn. (5)}$$

where $g_{i,j}$ is the path gain between the base station and a $cell_j$; $P(L_j)$ is the maximum power level specified for $cell_j$; and L_j is the minimum attenuation level set in $cell_j$.

To predict the total interference $i_{i,tot}$ in $cell_i$, the mobile switching center will maintain a "cell list" which lists all cells within the area surrounding $cell_i$. This cell list may also include a record of the maximum mobile station power level (L_j) allowed in the cell. The maximum power level information is not essential, and may be omitted from exemplary embodiments of the invention, but will reduce unnecessary signaling in the system. If a record of the the maximum mobile station power level is not maintained, then the MSC will assume that the maximum mobile station power level is the level specified in the air specification. Additionally, the mobile switching center will maintain a RF channel table which specifies all RF channels and which further specifies the cells that support each RF channel.

By using the predicted path gains and the cell list information, and applying equation 5 above, the MSC can estimate (6, Figure 3) the co-channel interference from every cell in the concerned designation list. The total estimated interference in $cell_i$ is thus given by:

$$i_{i,tot}(\underline{L})=\sum_{j=1}^{n} i_{i,j}(L_j)=\sum_{j=1}^{n} g_{i,j}*P(L_j) \qquad \text{Eqn (6)}$$

where $\underline{L} = (L_1, L_2, \ldots, L_n)$

From equation 6, the interference contribution $i_{i,,j}(L_j)$ of each $cell_j$ of the total estimated interference can be determined. When, as shown in step 7 of Figure 3, the interference contribution $i_{i,j}$ of each $cell_j$ is determined to be greater than the desired interference ($i_{desired}$), the power level L_j of that $cell_j$ is recalculated such that $i_{i,j}(L_j)$ is less than the desired interference (where $i_{desired}=i_{old}-\Delta Q$).

At step 8 of Figure 3, the interference contributions of each $cell_j$, based on the recalculated power levels L_{new}, are then summed to produce the estimated total interference $i_{i,tot}(\underline{L}_{new})$. In step 9, this estimated total interference is then compared with the desired interference level. If the estimated total interference is greater than the desired interference, then the attenuation level L of the most interfering cell is increased

one level. In step 10, the total interference is again estimated based on the change in attenuation level of the most interfering cell. This re-estimated value is then compared with the desired interference. If the re-estimated total interference remains greater than $i_{desired}$ then the attenuation level L of the most interfering cell is increased one level. Steps 8 and 9 are repeated until the re-estimated total interference is less than $i_{desired}$.

For each mobile station that needs its power level limited the mobile switching center will send the message 'LimitMsPow' (15, Figure 1) with the parameter "MaxPL" to the base station handling the call. On reception of this message each base station will compare MaxPL with the mobiles current power level and reduce it if necessary by sending a Power Change (16, Figure 1) Physical Layer Control message with DMAC=MaxPL.

When the high priority call is released (step 24, Figure 2 and 17, Figure 1), the MSC will send the message 'AbolishMsLimit' (18, Figure 1) to all base stations affected by the high priority call. This message will inform the base stations to revert to their normal values of maximum mobile station powers.

One skilled in the art will recognize that the above exemplary techniques for reducing the uplink power levels of co-channel mobiles can also be applied to limiting the downlink radiated power on co-channels. This can be achieved in those systems where the air interface standard specifies that the mobile station measure and report the downlink received signal strength and a value related to C/I (e.g., BER) and further where base stations in the system have the capability of controlling downlink radiated power. The exemplary techniques, described above, can thus be applied in a similar fashion as the uplink case, with the downlink quality threshold (DQT) being set to the same value as the UQT.

Exemplary embodiments of the present invention therefore provide techniques for increasing carrier to interference ratios so as to improve the voice quality of emergency or high priority calls. By making the determinations of whether to increase or decrease mobile station transmitted power in the MSCs or BSs, the exemplary embodiments of the invention will not require any hardware/software changes in the

mobile stations and therefore will advantageously function with all existing mobile stations that obey an air specification standard which uses power control.

Although a number of embodiments are described herein for purposes of illustration, these embodiments are not meant to be limiting. Those skilled in the art will recognize modifications that can be made in the illustrated embodiments. Such modifications are meant to be covered by the spirit and scope of the appended claims.

What is Claimed is:

1. A method for improving voice quality of calls in a radiocommunications network comprising the steps of:

designating said calls as high priority based on a transmitted parameter associated with said calls; and

said network modifying transmitted power associated with said calls based on said high priority designation so as to improve the voice quality of said calls over at least a portion of said calls.

2. The method of claim 1, wherein said high priority call is an emergency call.

3. The method of claim 1, wherein the transmitted power associated with said high priority calls is increased by a specified factor.

4. The method of claim 1, further comprising the step of:

modifying transmitted power associated with calls other than said designated high priority calls so as to improve said voice quality over at least a portion of said high priority calls.

5. The method of claim 4, wherein the transmitted power associated with said calls other than said high priority calls is kept below a specified level.

6. The method of claim 5, wherein said specified level is based on estimated transmitter-to-receiver relationships.

7. The method of claim 1, wherein said parameter is a called party number.

8. The method of claim 1, wherein said parameter is a mobile subscriber identity.

9. A method for improving voice quality of calls in a radiocommunication network, comprising the steps of:

designating said calls as high priority based on a transmitted parameter associated with said calls; and

modifying transmitted power of calls other than said high priority calls, based on said high priority designation, so as to improve said voice quality over at least a portion of said designated high priority calls.

10. A system for improving voice quality of calls in a radiocommunications network comprising:

means for designating said calls as high priority based on a transmitted parameter associated with said calls; and

means for modifying transmitted power associated with said calls based on said high priority designation so as to improve the voice quality of said calls over at least a portion of said calls.

11. The system of claim 10, wherein said high priority call is an emergency call.

12. The system of claim 10, wherein the transmitted power associated with said high priority calls is increased by a specified factor.

13. The system of claim 10, further comprising:

means for modifying transmitted power associated with calls other than said designated high priority calls so as to improve said voice quality over at least a portion of said high priority calls.

14. The system of claim 13, wherein the transmitted power associated with said calls other than said high priority calls is kept below a specified level.

15. The system of claim 14, wherein said specified level is based on estimated transmitter-to-receiver relationships.

16. The system of claim 10, wherein said parameter is a called party number.

17. The system of claim 10, wherein said parameter is a mobile subscriber identity.

18. A system for improving voice quality of calls in a radiocommunication network, comprising:

means for designating said calls as high priority based on a transmitted parameter associated with said calls; and

means for modifying transmitted power of calls other than said high priority calls, based on said high priority designation, so as to improve said voice quality over at least a portion of said designated high priority calls.

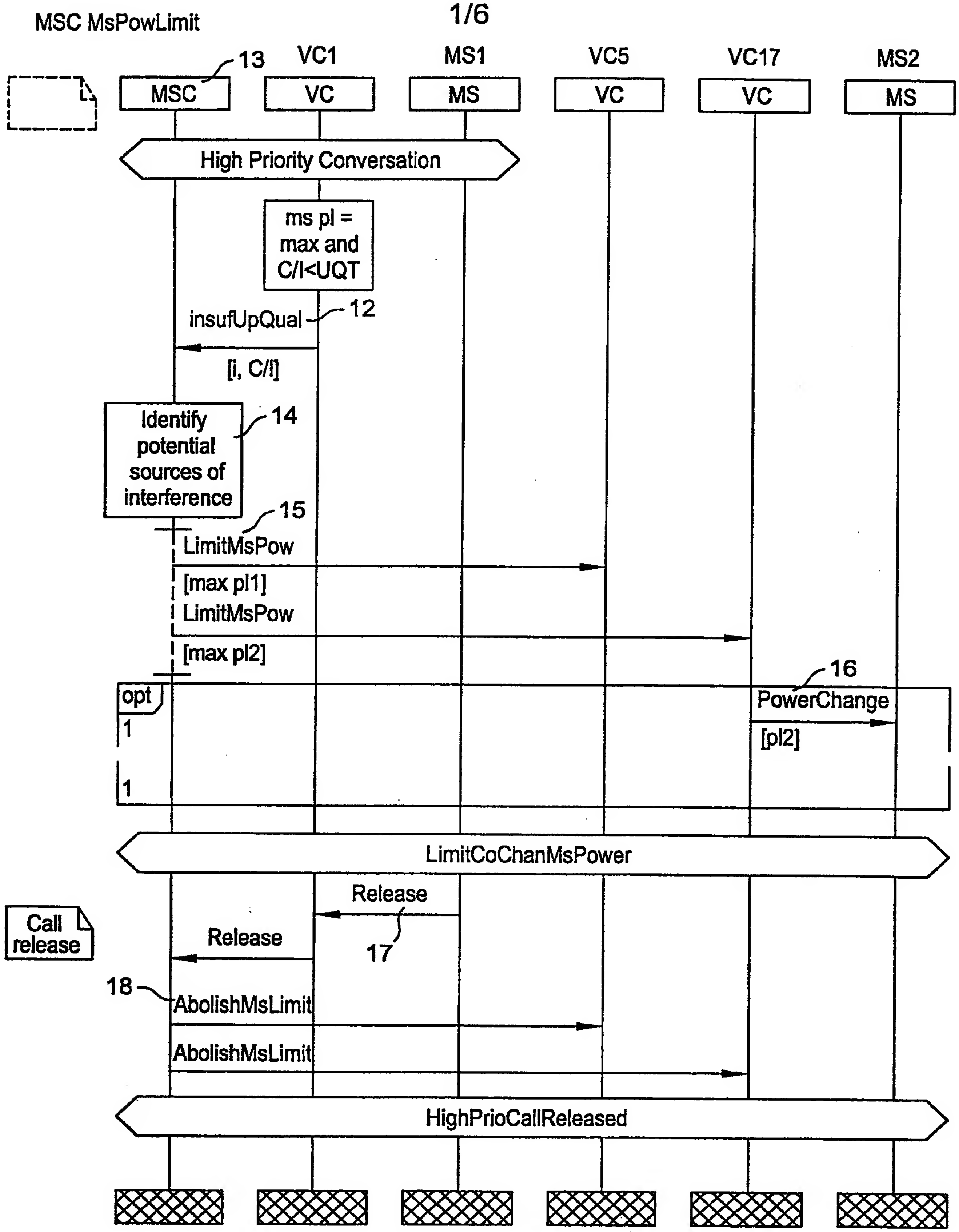

Fig. 1 Limitation of co-channel mobiles power

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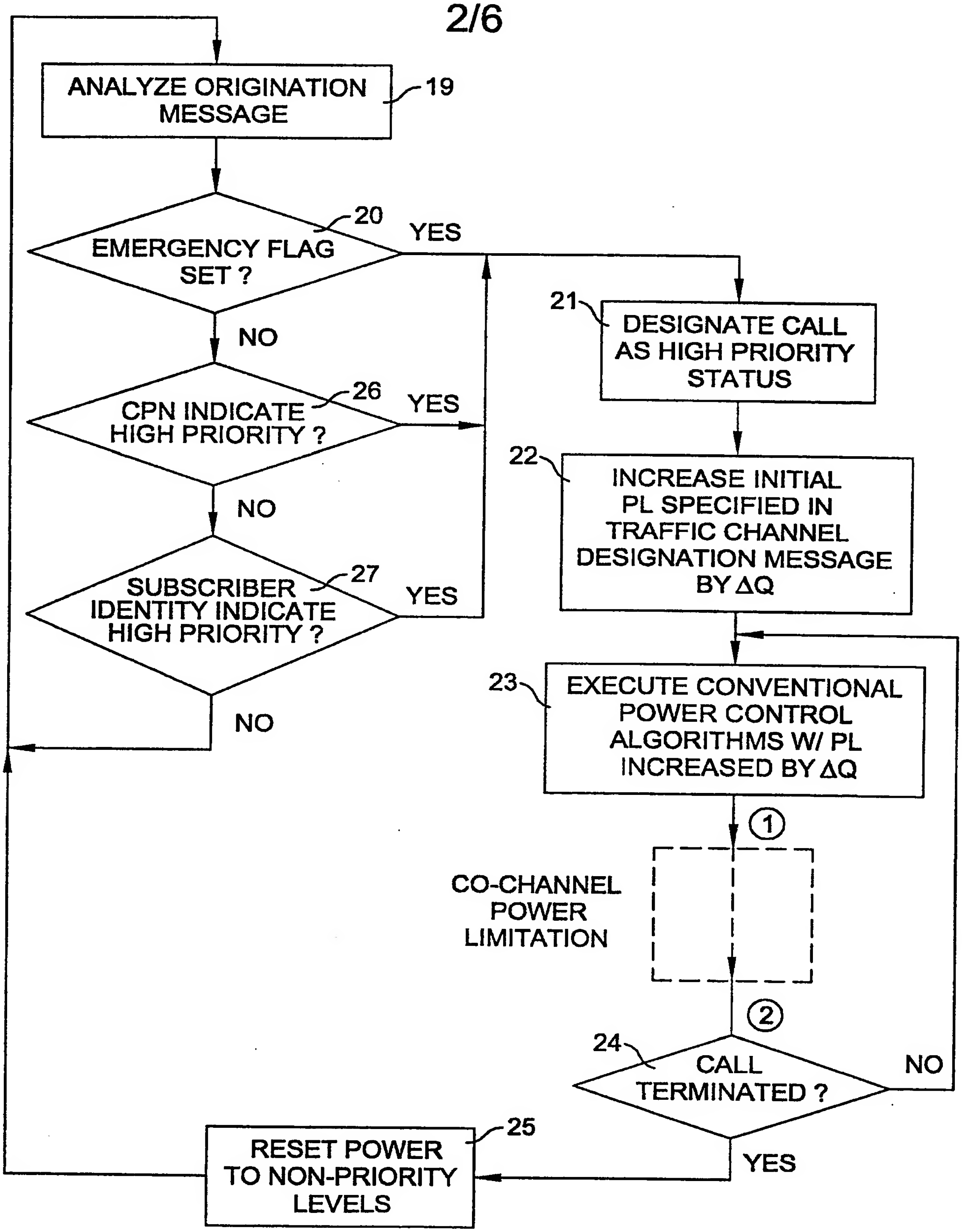
ANALYZE ORIGINATION MESSAGE
19
EMERGENCY FLAG SET ?
20
YES
NO
CPN INDICATE HIGH PRIORITY ?
26
YES
NO
SUBSCRIBER IDENTITY INDICATE HIGH PRIORITY ?
27
YES
NO
21
DESIGNATE CALL AS HIGH PRIORITY STATUS
22
INCREASE INITIAL PL SPECIFIED IN TRAFFIC CHANNEL DESIGNATION MESSAGE BY ΔQ
23
EXECUTE CONVENTIONAL POWER CONTROL ALGORITHMS W/ PL INCREASED BY ΔQ
1
CO-CHANNEL POWER LIMITATION
2
24
CALL TERMINATED ?
NO
YES
25
RESET POWER TO NON-PRIORITY LEVELS

Fig. 2

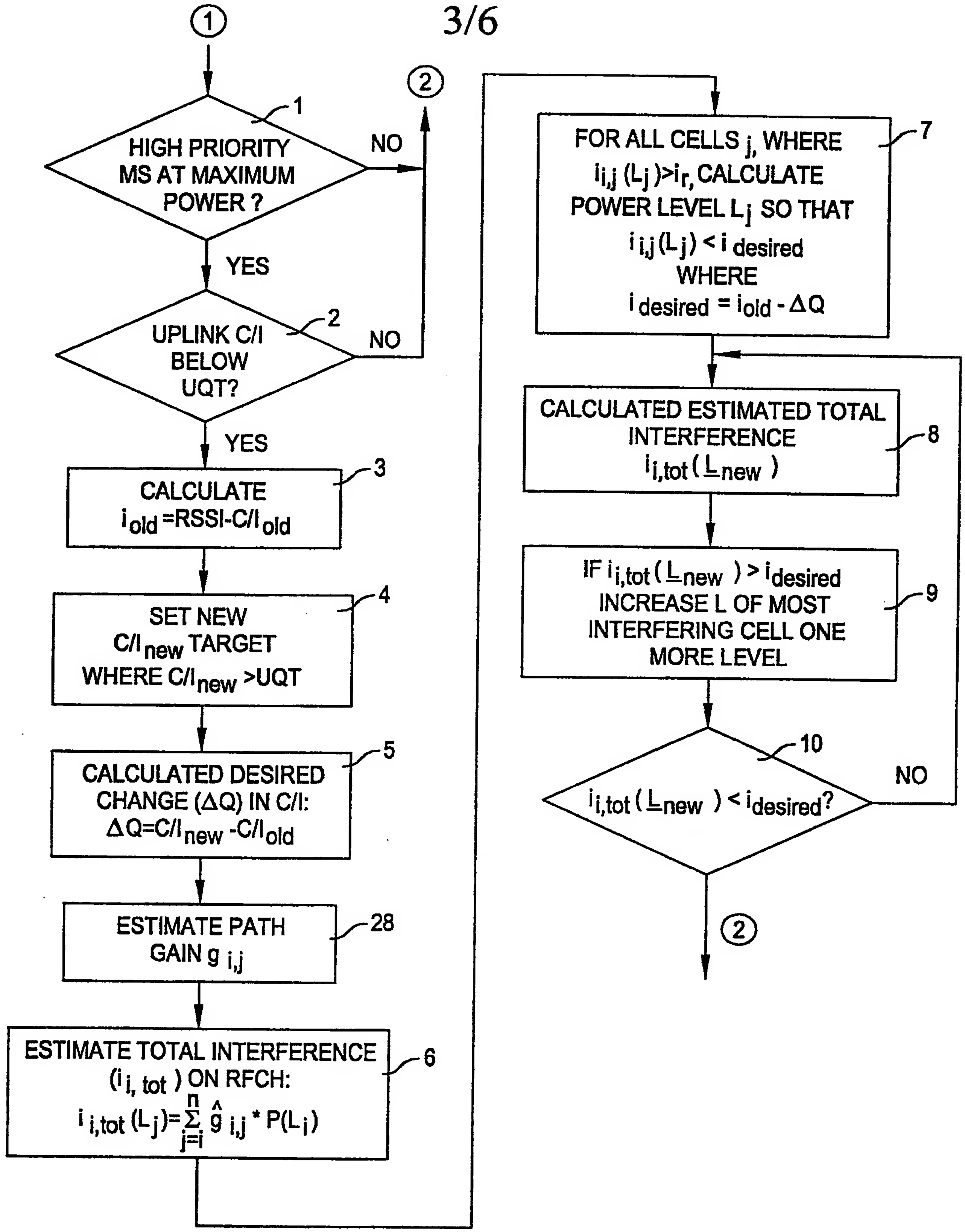
1
HIGH PRIORITY MS AT MAXIMUM POWER ?
NO
2
YES
UPLINK C/I BELOW UQT?
2
NO
YES
CALCULATE i_{old}=RSSI-C/I_{old}
3
SET NEW C/I_{new} TARGET WHERE C/I_{new} >UQT
4
CALCULATED DESIRED CHANGE (ΔQ) IN C/I: ΔQ=C/I_{new} -C/I_{old}
5
ESTIMATE PATH GAIN $g_{i,j}$
28
ESTIMATE TOTAL INTERFERENCE ($i_{i, tot}$) ON RFCH: $i_{i,tot}(L_j)=\sum_{j=i}^{n} \hat{g}_{i,j} * P(L_i)$
6
FOR ALL CELLS j, WHERE $i_{i,j}(L_j)>i_r$, CALCULATE POWER LEVEL L_j SO THAT $i_{i,j}(L_j) < i_{desired}$ WHERE $i_{desired} = i_{old} - \Delta Q$
7
CALCULATED ESTIMATED TOTAL INTERFERENCE $i_{i,tot}(L_{new})$
8
IF $i_{i,tot}(L_{new}) > i_{desired}$ INCREASE L OF MOST INTERFERING CELL ONE MORE LEVEL
9
10
$i_{i,tot}(L_{new}) < i_{desired}$?
NO
2

Fig. 3

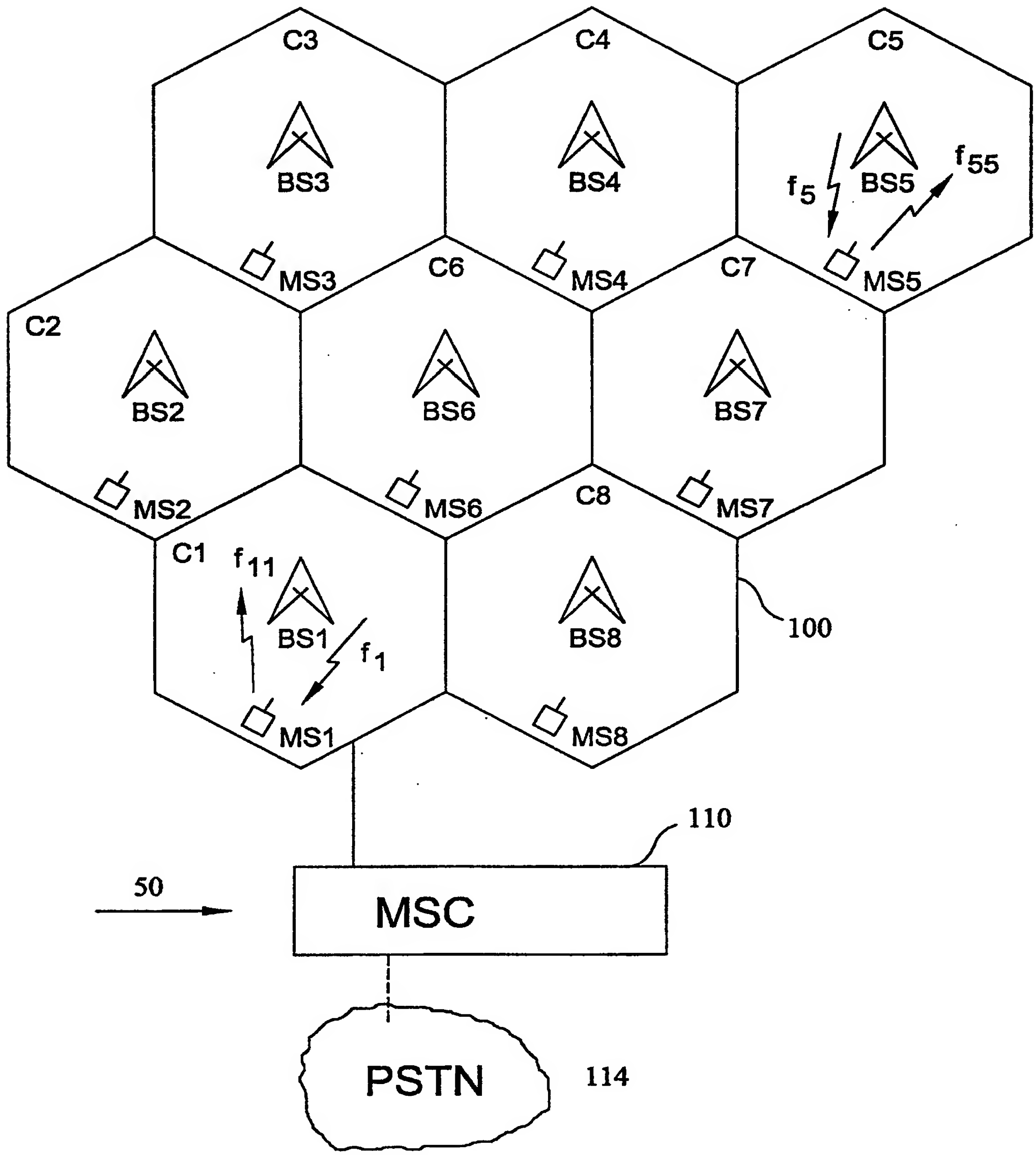
C3
C4
C5
BS3
BS4
BS5
f_5
f_{55}
MS3
MS4
MS5
C6
C7
C2
BS2
BS6
BS7
MS2
MS6
MS7
C8
C1
f_{11}
BS1
f_1
BS8
100
MS1
MS8
110
50
MSC
PSTN
114

Fig. 4

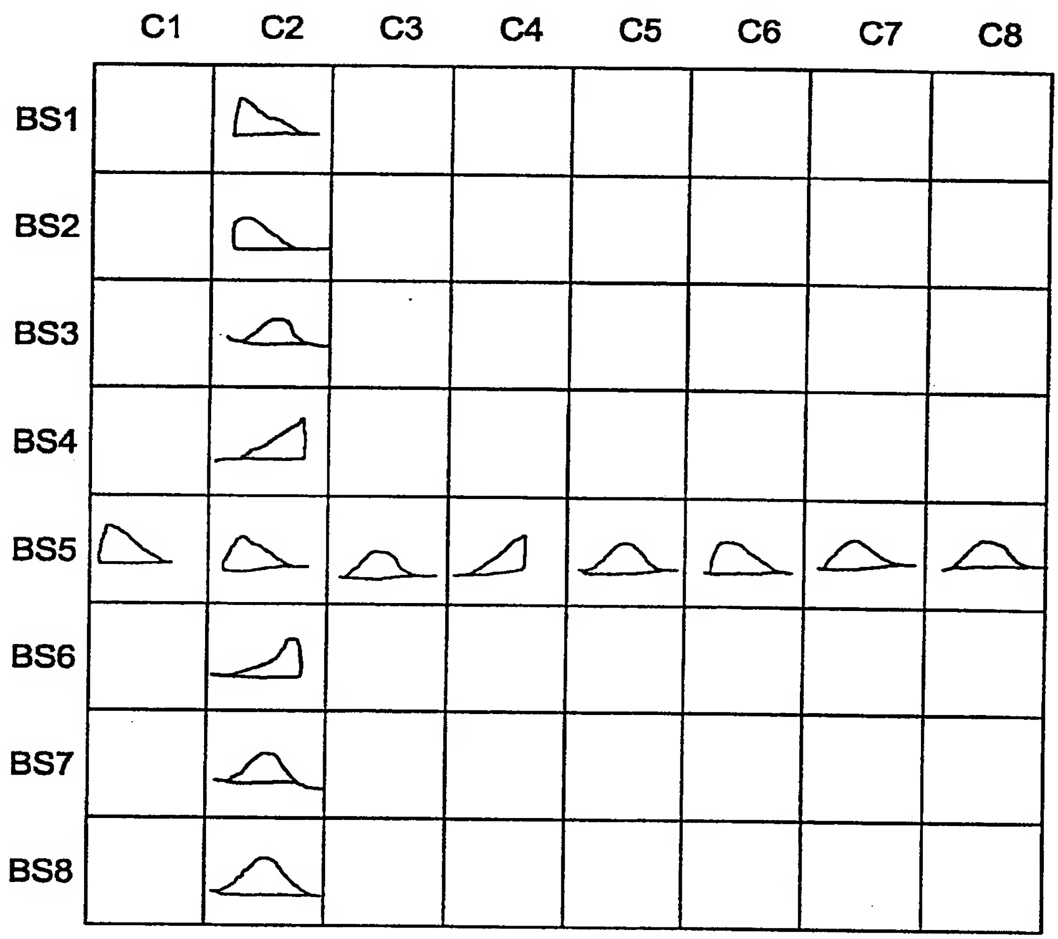

Fig. 5

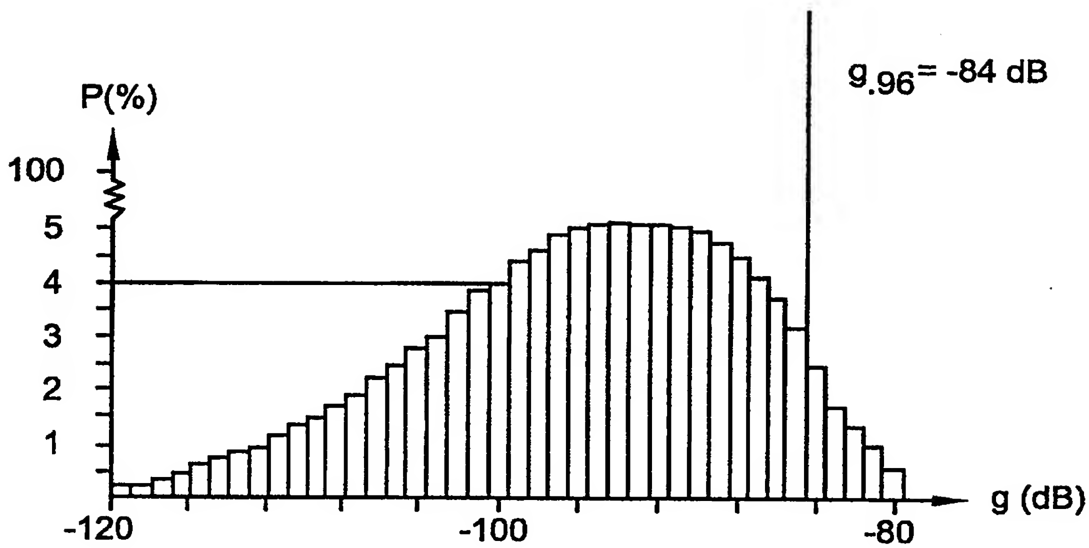

Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/SE 99/02410

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/005

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 95 24102 A (NOKIA TELECOMMUNICATIONS OY ;JOLMA PETRI (FI); SAVUSALO JARI (FI);) 8 September 1995 (1995-09-08) abstract page 4, line 16 -page 5, line 11 page 5, line 27 -page 6, line 29 claims 1,2 --- -/--	1-3,7,8, 10-12, 16,17 4,9,13, 18

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 March 2000	10/04/2000

Name and mailing address of the ISA	Authorized officer
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PCT/SE 99/02410

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 98 48575 A (ERICSSON GE MOBILE INC) 29 October 1998 (1998-10-29) abstract page 5, line 16 - line 22 page 9, line 24 -page 10, line 5 page 11, line 19 -page 13, line 16 page 14, line 21 -page 15, line 11	1-3,7, 10-12,16 4,9,13, 18
A	US 5 678 188 A (HISAMURA MASAYUKI) 14 October 1997 (1997-10-14) abstract column 1, line 64 -column 2, line 29 column 4, line 41 -column 5, line 39 column 6, line 48 -column 7, line 33	1,2,4,7, 9-11,13, 16,18
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1

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